Statistical_Inference Project

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Overview The project aim is to analyze the ToothGrowth data in the R datasets package.

Load the necessary packages

```
library(ggplot2)
library(tinytex)
library(datasets)
```

1. Load the ToothGrowth data and perform some basic exploratory data analyses

```
data(ToothGrowth)
str(ToothGrowth)
```

```
## 'data.frame':    60 obs. of  3 variables:
##  $ len : num  4.2 11.5 7.3 5.8 6.4 10 11.2 11.2 5.2 7 ...
##  $ supp: Factor w/ 2 levels "OJ","VC": 2 2 2 2 2 2 2 2 2 2 ...
##  $ dose: num  0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 ...
```

```
head(ToothGrowth, 4)
```

```
##    len supp dose
## 1  4.2   VC  0.5
## 2 11.5   VC  0.5
## 3  7.3   VC  0.5
## 4  5.8   VC  0.5
```

```
tail(ToothGrowth, 4)
```

```
##     len supp dose
## 57 26.4   OJ    2
## 58 27.3   OJ    2
## 59 29.4   OJ    2
## 60 23.0   OJ    2
```

Summary of the data

```
summary(ToothGrowth)
```

```
##       len        supp         dose
##  Min.   : 4.20   OJ:30   Min.   :0.500
##  1st Qu.:13.07   VC:30   1st Qu.:0.500
##  Median :19.25           Median :1.000
##  Mean   :18.81           Mean   :1.167
##  3rd Qu.:25.27           3rd Qu.:2.000
##  Max.   :33.90           Max.   :2.000
```

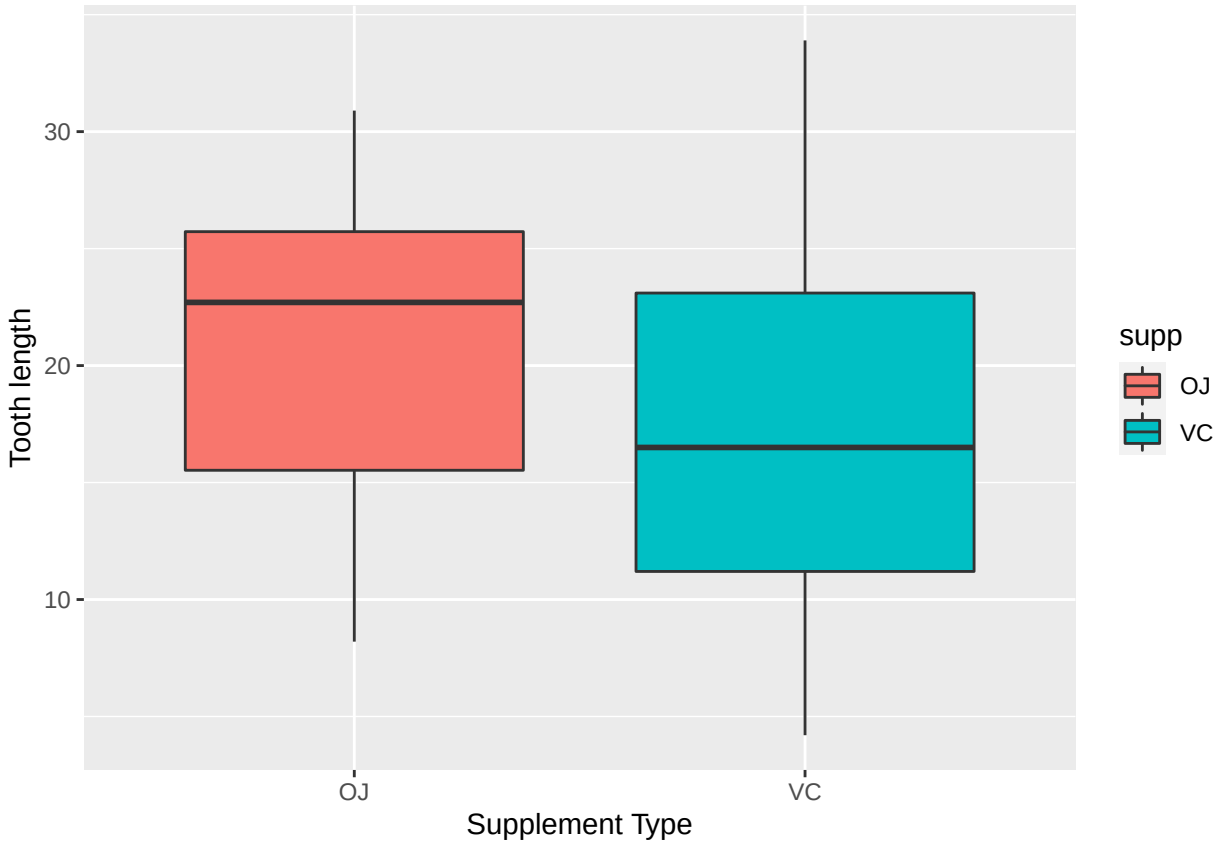
2.Basic summary of the data

```
# Calculatiing the mean of len based on the supplement methods
Supplement_mean = split(ToothGrowth$len, ToothGrowth$supp)
sapply(Supplement_mean, mean)
```

```
##       OJ       VC
## 20.66333 16.96333
```

Graph

```
ggplot(aes(x=supp, y=len), data=ToothGrowth) + geom_boxplot(aes(fill=supp))+
        xlab("Supplement Type") +ylab("Tooth length")
```



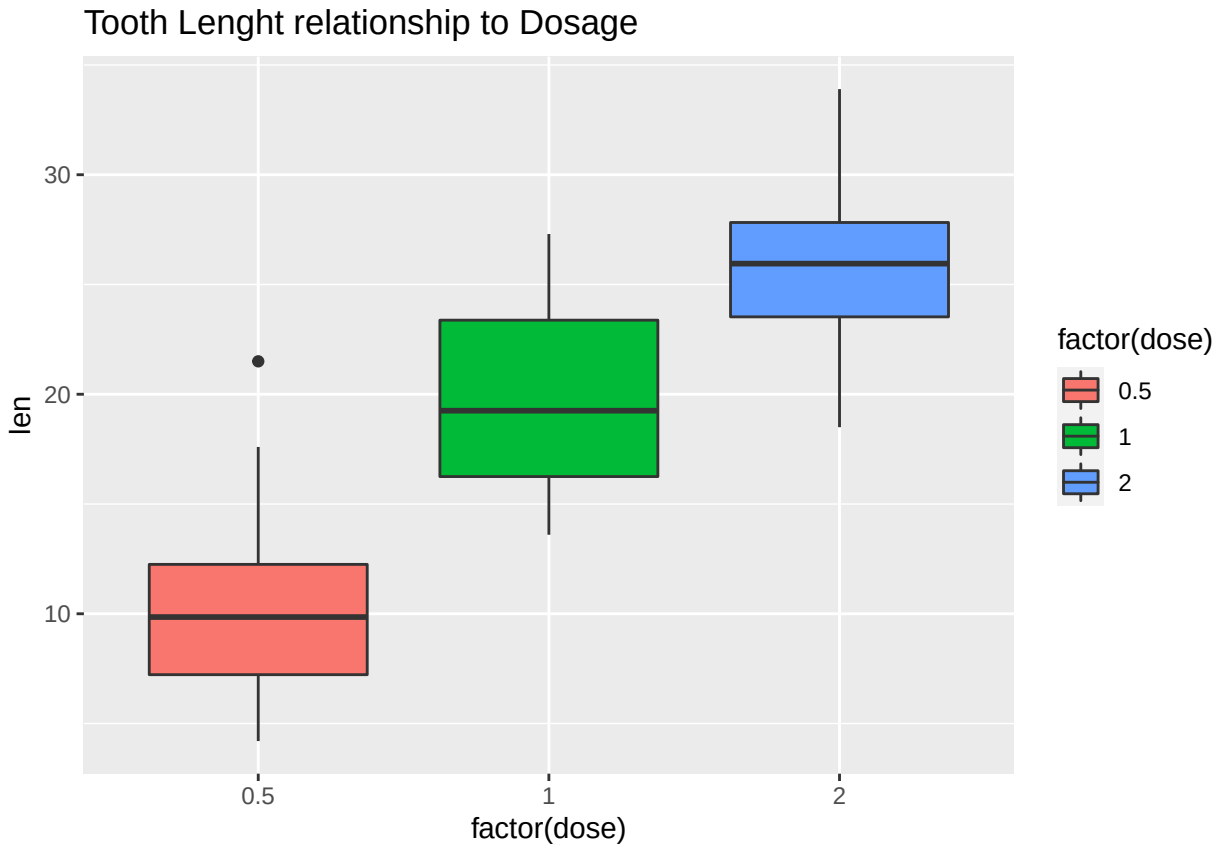
3. Using confidence intervals to compare growth of tooth by supplement dose

```
unique(ToothGrowth$dose)
```

```
## [1] 0.5 1.0 2.0
```

There are 3 dose groups: 0.5, 1, and 2 Graph shows relationship between Tooth length to Dose

```
g <- ggplot(aes(x = factor(dose), y = len), data = ToothGrowth) +
    geom_boxplot(aes(fill = factor(dose)))
g <- g + labs(title="Tooth Lenght relationship to Dosage")
print(g)
```



T-test for dose 0.5 mg:

```
t.test(len ~ supp, ToothGrowth[ToothGrowth$dose == .5, ])
```

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = 3.1697, df = 14.969, p-value = 0.006359
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  1.719057 8.780943
## sample estimates:
## mean in group OJ mean in group VC
##            13.23             7.98
```

T-test for dose 1 mg:

```
t.test(len ~ supp, ToothGrowth[ToothGrowth$dose == 1, ])
```

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = 4.0328, df = 15.358, p-value = 0.001038
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  2.802148 9.057852
## sample estimates:
## mean in group OJ mean in group VC
##            22.70            16.77
```

T-test for dose 2 mg:

```
t.test(len ~ supp, ToothGrowth[ToothGrowth$dose == 2, ])
```

```
##
##  Welch Two Sample t-test
##
## data:  len by supp
## t = -0.046136, df = 14.04, p-value = 0.9639
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -3.79807  3.63807
## sample estimates:
## mean in group OJ mean in group VC
##            26.06            26.14
```

Conclusion:

For all three dosages, the p-value of this test is is less than 0.5, a evidence that we can reject the null hypothesis. We can infer that supplement type has no effect on tooth growth, and increasing the dose level leads to increased tooth growth.